

NEW SIPHONAPTERA FROM EASTERN MEDITERRANEAN COUNTRIES

By F. G. A. M. SMIT

TWELVE new species or subspecies of fleas, from Egypt, Israel and Iran, are described below. The material from Egypt (Sinai) and Israel, largely collected by Dr. M. Costa as a basis for his studies for his doctoral thesis, was kindly submitted to me for study and description by Prof. O. Theodor of the Hebrew University, Jerusalem. The holotypes, allotypes and several paratypes of these new fleas, as well as specimens of known species, were generously presented to the British Museum collection of fleas at Tring by Professor Theodor, to whom I am deeply indebted for this valuable donation. I am also very grateful to Dr. Costa for his great enterprise in collecting fleas in Israel, a country which is zoogeographically of great interest since its fauna contains elements of African, European and Asian origin, apart from endemic species.

Dr. G. Bouvier, Director of the Galli-Valerio Institute at Lausanne, very kindly presented some fleas, one of them new to science, which were collected by Dr. F. Schmid in Iran.

The material of the two new subspecies of *Nosopsyllus sarinus* was already in the collection of fleas at Tring.

Ctenocephalides arabis *multispinosus* subsp. n.

(Text-fig. 1)

TYPE MATERIAL : Male holotype, female allotype and 1 ♂, 1 ♀ paratypes from Wadi Karkara, Israel, from *Procavia capensis syriaca*, 3.viii.1957 (*M. Costa*).

DESCRIPTION : The only detectable difference from the nominate subspecies (which was described from Wasil in the Yemen, Arabia, from *Procavia capensis jayakari*) is that the new subspecies has 6 or 7 spines in the genal ctenidium in the male (Fig. 1) and doubtless also in the female, though the two available specimens of this sex both have 7 genal spines on each side of the head. In the original description (Jordan, 1925 : 97, repeated by Hopkins & Rothschild, 1953 : 142) it is stated that *C. arabis* has one to three genal spines, but re-examination of the type series (1 ♂, 4 ♀) showed that in some of the specimens one or two spines are broken off and that the number of genal spines is actually 3 or 4 (in three specimens 3 on each side, in the other two 3 on one side of the head, 4 on the other). Jordan (1925 : 97) gives the number of spines in the pronotal ctenidium as 9 in the male, 11 or 12 in the female. Actually, in the male it is clear that a dorsal spine is broken

off and that the number is therefore 10. Only one of the four females has 11 pronotal spines, the other three specimens all have 12 spines. In *C. arabicus multispinosus* there are 10 pronotal spines in the male, 12 in the female. These appear to be the normal numbers; the sexual difference in these numbers is worth noting.

REMARKS: It is most unusual to evaluate differences in the number of spines of a genal ctenidium as being of no greater than subspecific significance, but in the genus *Ctenocephalides* there is a strong tendency for this ctenidium to become vestigial and the number of spines is in this instance obviously of no great phylogenetic importance.

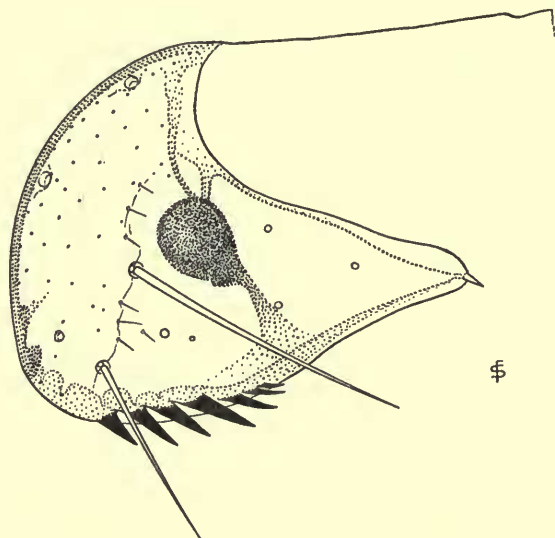


FIG. 1. *Ctenocephalides arabicus multispinosus* subsp. nov.
Preantennal part of head (holotype).

Xenopsylla dipodilli sp. n.

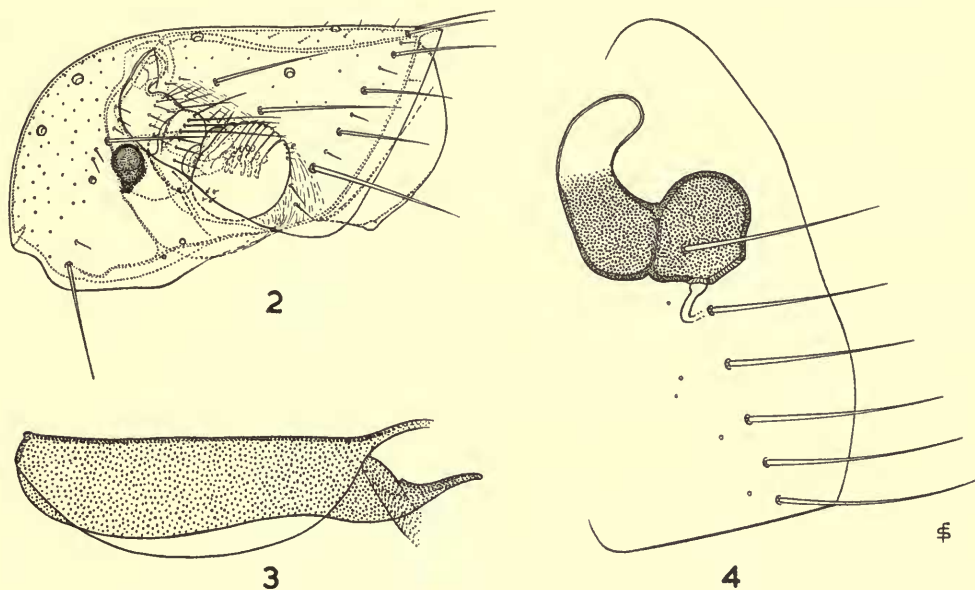
(Text-figs. 2-7)

TYPE MATERIAL: Collected by M. Costa from *Gerbillus* (*Dipodillus*) *dasyurus*: male holotype and 2 ♂, 2 ♀ paratypes from Wadi Nafkh, Israel, 11.iv.1955, female allotype from Qasr Mahalla (Raman), Israel, 12.iv.1955; 2 ♂ 2 ♀ paratypes from Wadi Raman, 25.x.1954; 1 ♂ paratype from Eilath, Israel, 12.iv.1954; 1 ♂ paratype from Ras ez Zuweira, Israel, 3.iii.1955; 1 ♂, 1 ♀ paratypes from Ein el Kudeirath, Sinai, Egypt, 30.xi.1956. Collected by O. Theodor from *Meriones crassus*: 1 ♂ paratype from Wadi Jureir, Negev, Israel, 1.iv.1955.

The following paratypes, all collected by Dr. H. Hoogstraal of the U.S. Navy Medical Research Unit at Cairo, are in the collection of Col. R. Traub, who generously invited me to study them and to incorporate their data in this description: 1 ♂ from Yemen, Arabia, 4000 ft., from a gerbil, 17.i.1951; 1 ♀ from Yemen, 3700 ft.,

from a gerbil, 20.I.1951; 2 ♀ from St. Catherine's Monastery, Sinai, Egypt, 5000 ft., from *Gerbillus calurus*, 16.V.1953; 3 ♀ from Wadi El Sheikh, nr. St. Catherine's Monastery, 5000 ft., from *Gerbillus* (*Dipodillus*) sp., V.1953; 1 ♂ from the same locality, from *Meriones* sp., 19.V.1953; 1 ♀ from El Raba, nr. St. Catherine's Monastery, 5000 ft., from *Gerbillus calurus*, 17.V.1953.

DIAGNOSIS: This new species is nearest related to *Xenopsylla nubica* (Rothschild, 1903) and differs from it by the following features: (a) a considerably smaller eye, (b) a more rounded antennal clava, (c) absence of a tooth-like projection on the anterior part of the ventral margin of the hind femur, (d) the penultimate notch of



FIGS. 2-4. *Xenopsylla dipodilli* sp. nov. 2. Head (♂ paratype from Wadi Nafkh). 3. Aedeagal apodeme (holotype). 4. Sternum VII and spermatheca (allotype).

the hind tibia bears three setae, (e) fewer setae in the tergal rows, (f) while the male genitalia are almost identical with those of *X. nubica*, the spermatheca of the female differs considerably from that of the latter species. A related species, *X. nesokiae* Ioff, a parasite of *Nesokia indica* in Central Asia, also has a small eye, but its aedeagus is like that of *X. astia* Rothschild.

DESCRIPTION. *Head* (Text-fig. 2): Eye small; antennal clava globular (in *X. nubica* it usually has a tapering apex, especially in the male); occipital groove in male as shallow as in *X. nubica*, not extending on to the pronotum. *Thorax*: virtually as in *X. nubica*. *Legs* (Text-fig. 7): two strong setae posteriorly near apex of hind coxa instead of the three usually present in *X. nubica*; ventral margin of hind femur smoothly rounded anteriorly, without a sharp tooth-like projection such as is present in *X. nubica*; two setae ventro-apically on outer surface of hind femur; penultimate notch of hind tibia bearing three setae, as against two in



FIGS. 5-7. *Xenopsylla dipodilli* sp. nov. 5. Processes of clasper (holotype). 6. Processes of clasper (paratype from Wadi Nafkh). 7. Hind femur and tibia (allotype).

X. nubica; longest seta of first hind tarsal segment reaching to or a little beyond apex of second segment; longest seta of second hind tarsal segment reaching to or beyond middle of fifth segment. *Abdomen*: terga III-VI with a row of 6-8 setae on each side in both sexes (in *X. nubica* 9-12). In other respects the unmodified abdominal segments resemble those of *X. nubica*.

Male (Text-figs. 3, 5, 6): Modified segments and genitalia virtually identical with those of *X. nubica*; processes of clasper as in Text-figs. 5 and 6; aedeagal

apodeme as in Text-fig. 3. The aedeagus may differ in some small details, but in mounted specimens of *X. nubica* the apical portion of this structure is distorted in various ways and on the basis of available material I cannot make out with certainty what the normal arrangement would be like.

Female (Text-fig. 4) : Terminal segments almost as in *X. nubica*. Bulga of spermatheca forming an almost hemispherical expansion opposite the orifice of the duct, its lower margin fairly straight ; base of hilla not broader than the bulga and only slightly ventricose ; the dark coloration extends to beyond the middle of the hilla. On the whole the spermatheca is reminiscent of that of *X. brasiliensis* (Baker) rather than that of *X. nubica*.

LENGTH : ♂ $1\frac{1}{2}$ mm., ♀ $1\frac{1}{2}$ –2 mm. (*X. nubica* : ♂ $1\frac{1}{2}$ –2 mm., ♀ 2 – $2\frac{1}{4}$ mm.).

***Ctenophthalmus (Euctenophthalmus) congener tenuistigmatus* subsp. n.**

(Text-figs. 8, 9)

Ctenophthalmus congener Roths. (nec Rothschild, 1907). Costa, 1954, *Bull. Res. Council Israel* 4 (3) : 293–296 [locality not mentioned, but Prof. O. Theodor informed me that the 202 ♂ and 149 ♀ recorded in Costa's paper were collected at Ginegar in the Plain of Esdraelon, south of Nazareth, Israel].

TYPE MATERIAL : Collected by M. Costa from *Microtus guentheri* : male holotype and 2 ♂ paratypes from Mishmar Haemek, Israel, 4.i.1953 ; female allotype and 1 ♂, 2 ♀ paratypes from Mishmar Haemek, 10.i.1953 ; 1 ♂, 1 ♀ paratypes from Mishmar Haemek, 2.i.1953 ; 11 ♂, 11 ♀ from Ginegar, Israel, 6.viii.1947 (1 ♂, 1 ♀), 22.viii.1947 (2 ♂, 2 ♀), 23.viii.1947 (2 ♂), 4.ix.1947 (1 ♂, 1 ♀), 7.ix.1947 (2 ♂, 2 ♀), 3.x.1947 (3 ♂, 5 ♀).

DESCRIPTION : This new subspecies is closely related to *C. congener allousei* Hubbard, 1956 (from Kurdistan, Iraq), and differs from it by (a) the pronotum being longer in relation to the length of the pronotal spines, (b) a longer dorso-posterior margin of the fixed process of the clasper (Text-fig. 8), with four long setae situated along this margin as against three in *C. congener allousei*, (c) a considerably smaller spiracular fossa of tergum VIII of the female (Text-fig. 9) (In certain genera there seems to be a correlation between the size of the spiracular fossae (especially the one on tergum VIII) and the humidity of the fleas' habitat—the size of the fossae becoming greater with an increase in the relative humidity.) The movable process of the clasper (Text-fig. 8) is on the whole apically broader than in *C. congener allousei*, but there is some variation in this width and in some specimens the process is almost identical with that of the latter subspecies.

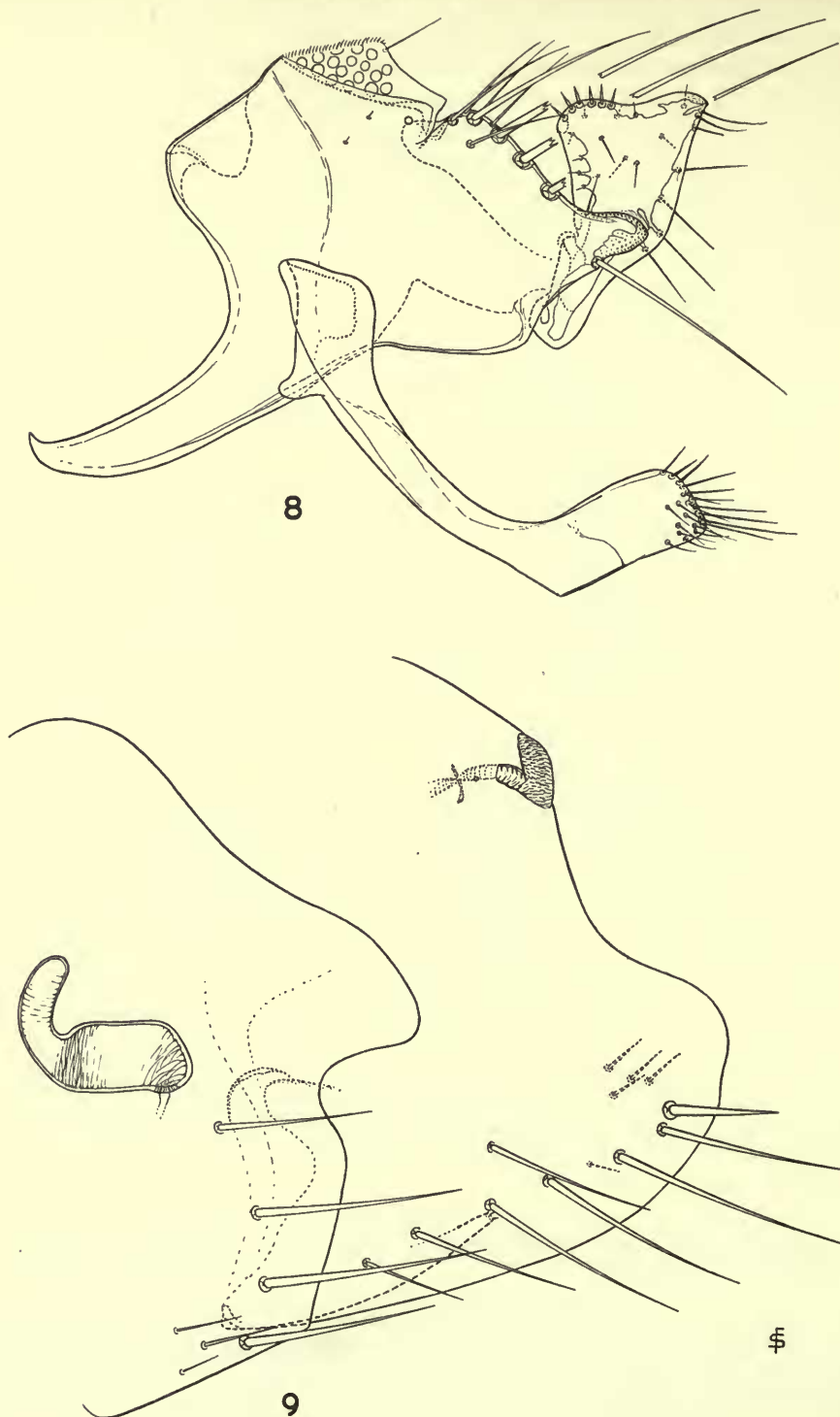
LENGTH : ♂ 2 mm., ♀ $2\frac{1}{2}$ mm.

***Ctenophthalmus (Euctenophthalmus) iranus persicus* subsp. n.**

(Text-figs. 10–13)

TYPE MATERIAL : Male holotype and female allotype collected at Kazvin, Iran, from a burrow of *Meriones persicus*, in 1955, by F. Schmid.

DIAGNOSIS : The male of this new subspecies is distinguishable from that of



FIGS. 8-9. *Ctenophthalmus* (*Euctenophthalmus*) *congener tenuistigmatus* subsp. nov. 8. Clasper and sternum IX (holotype). 9. Sternum VII, segment VIII and spermatheca (allotype).

C. iranus iranus Argyropulo, 1935 (from Azerbaijan*) by (a) the ventral emargination of the posterior margin of sternum VIII, (b) the much narrower dorsal portion of the movable process of the clasper which is longer than that of the nominate subspecies, (c) the more strongly pronounced sclerotic dorso-posterior angle of the movable process, (d) the relatively shorter distal arm of sternum IX. The female appears to be indistinguishable from that of the nominate subspecies. It should be noted that I have not seen any specimens of the nominate subspecies, so I am relying on Argyropulo's description and figures for the differences between the subspecies.

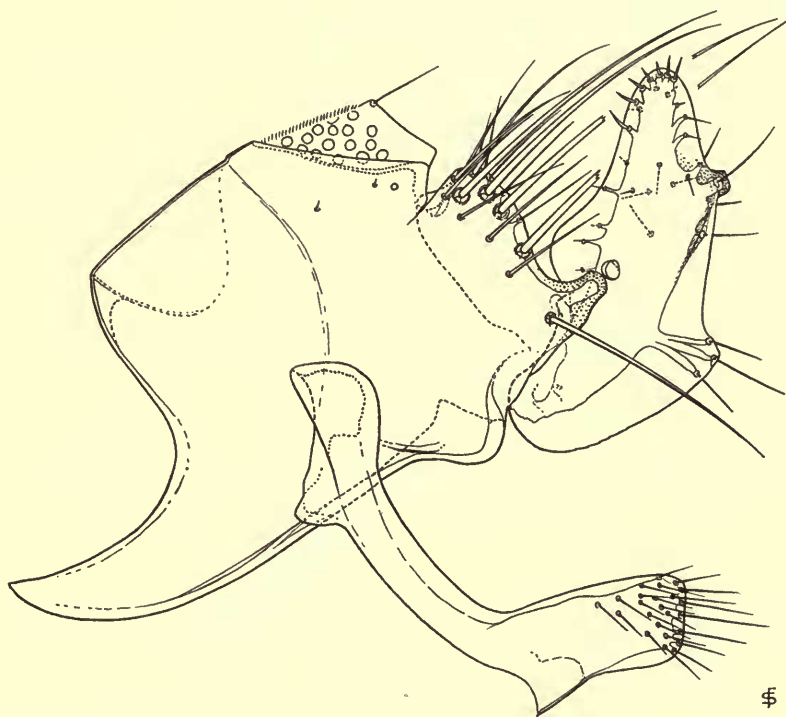
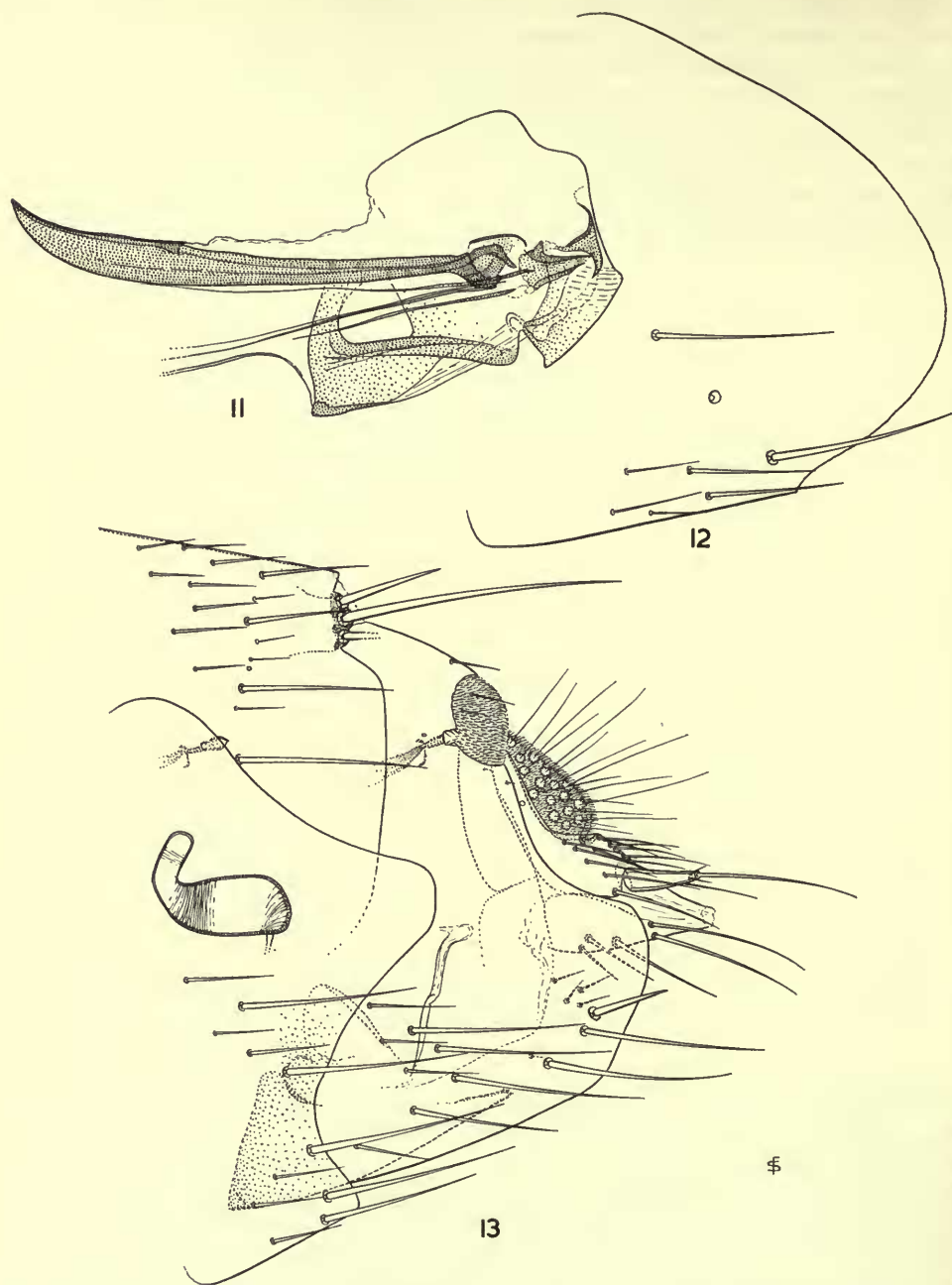


FIG. 10. *Ctenophthalmus* (*Euctenophthalmus*) *iranus persicus* subsp. nov. Clasper and sternum IX (holotype).

DESCRIPTION: Labial palp reaching to about four-fifths the length of the fore coxa. Pronotal ctenidium with 18 spines in the male, 16 in the female; these spines are slightly longer than the pronotum. Longest seta of second hind tarsal segment not quite reaching the middle of the fourth segment. Terga I–IV with one marginal spinelet on each side in both sexes (although in the female the spinelet is absent on one side of tergum IV). Numbers of setae in the main row on each side of terga I–VII in the male: 5, 7 or 8, 7, 7, 6, 7, and 6 respectively, in the female: 5, 7 or 8, 7, 6, 6 or 7, 6 and 4 respectively. Basal abdominal sternum with a pair of ventral setae in

* Argyropulo (1937: 105) gives the latitude and longitude of the localities (the neighbourhood of the villages Kalakhana and Kyal'zyaz) from which he obtained material as 38°39' N., 66°E.; the longitude must be incorrect since it would indicate a place in Uzbekistan and it is perhaps a slip for 46°E.



FIGS. 11-13. *Ctenophthalmus* (*Euctenophthalmus*) *iranensis persicus* subsp. nov. 11. Phallosome (holotype). 12. Sternum VIII (holotype). 13. Terminal abdominal segments and genitalia (allotype).

the male, with a vertical row of 2 or 3 setae in the female; sterna III–VII with a main row of four setae each side in the male, sterna III–VI with a main row of five setae in the female.

Male (Text-figs. 10–12): Two or three small setae in front of the spiracular fossa of tergum VIII. Posterior margin of sternum VIII (Text-fig. 12) minutely serrate, smoothly rounded and ventrally slightly emarginate. Fixed process of clasper (Text-fig. 10) with four large and about a dozen smaller setae; the narrow ventral lobe without a small dorso-apical seta; acetabular seta large, inserted well away from the margin. Movable process elongate, its anterior margin strongly bulging just above the acetabular portion; the dorso-anterior angle greatly drawn out so that the upper part of the movable process is shaped like a sugar-loaf, at the base of which the dorso-posterior angle forms a strongly sclerotized squarish projection; the group of setae on and near the posterior margin is placed rather low down at a projection of the margin and consists of only three setae (in the majority of species of the genus this group invariably consists of four setae): fovea small and circular; seven sensilla along the dorso-anterior angle. Distal arm of sternum IX (Text-fig. 10) short and broad, with numerous short setae in its apical half. Phallosome as in Text-fig. 11.

Female (Text-fig. 13): Posterior margin of sternum VII forming a large bluntly triangular lobe; the lower setae of the main row are placed quite near the posterior margin. Tergum VIII with 2 or 3 setae over and above the spiracular fossa; posterior margin of this tergum broadly rounded, without a sinus; four or five genital setae on the inner surface. Apical part of sternum VIII narrow. Ductus bursae very long, much longer than the dorsal pronotal spines. Spermatheca of the usual type, as shown in Text-fig. 13.

LENGTH: ♂ ♀ $2\frac{1}{2}$ mm.

***Ophthalmopsylla (Ophthalmopsylla) volgensis palestinica* subsp. n.**

(Text-figs. 14–16, 21)

TYPE MATERIAL: Male holotype and female allotype from Beer Hafir, Israel, from *Jaculus jaculus*, 25.iii.1957 (M. Costa).

DIAGNOSIS: At once distinguishable from the seven known subspecies of *O. volgensis* by (a) the middle seta of the ocular row being situated much nearer the lower than the upper ocular seta (in the other available subspecies this seta is placed midway between the upper and lower setae of the row), (b) the great reduction of the frontal row of setae, which is reduced to only one small seta in the male and none in the female (in the other subspecies the frontal row consists of at least three setae). In the latter respect females of the new subspecies resemble those of *O. praefecta* spp. (in which the row is present in the male), but in other characters the new form is a typical representative of the *volgensis*-complex. The genitalia of the male differ to some extent from those of the other subspecies, but this is not the case in the female, which is therefore indistinguishable from other subspecies in the structure of the terminal abdominal segments and genitalia.

DESCRIPTION : Chaetotaxy of head (Text-fig. 14) as described in the diagnosis. Pronotal ctenidium with 20 spines in the male, 22 in the female. Outer lateral surface of hind tibia with 10–11 setae in the male, 8–10 in the female. Posterior margin of hind tibia with one short but stout seta between the penultimate group of two setae and the fifth group of setae from the base. Metanotum with two marginal spinelets on each side in both sexes. Terga I–IV with one marginal spinelet each side (in the female only on one side of tergum IV, the spinelet being absent on the other side). Numbers of setae in the main row on each side of terga I–VII in the male : 4, 7, 7, 7, 7, 5 or 6 and 5 or 6 respectively, in the female : 4 or 5, 7, 7 or 8, 7, 7, 7 and 6 respectively. Basal abdominal sternum with, apart from a

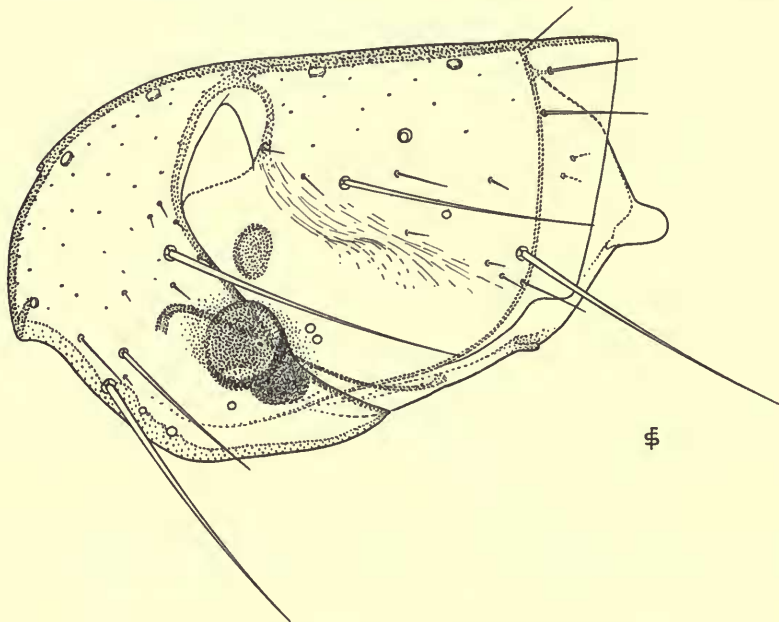


FIG. 14. *Ophthalmopsylla* (*Ophthalmopsylla*) *volgensis palestunica* subsp. nov.
Head (holotype).

ventral seta, 1 or 2 lateral setae per side in the male, 2 such setae in the female. Sterna III–VII in the male with the following numbers of setae each side : 3, 2 or 3, 3, 3, and 3 ; sterna III–VI in the female with 3, 3 or 4, 3 and 4 setae respectively.

Male (Text-figs. 15, 16) : Sternum VIII (Text-fig. 15) of the same peculiar structure as in the other subspecies. Tip of fixed process of clasper reaching a little beyond the middle of the anterior margin of the movable process ; corpus of clasper and manubrium virtually as in other subspecies. Movable process of clasper broad, widest in its middle, with a rounded posterior margin ; the two spiniform setae at the hind margin not close together, while the seta above the upper spiniform is not transformed into a spiniform (as is the case in the nominate subspecies, for instance) : chaetotaxy of movable process as shown in Text-fig. 15. Distal arm of sternum IX (Text-fig. 15) straight, even its tip hardly at all upturned ; ventrally

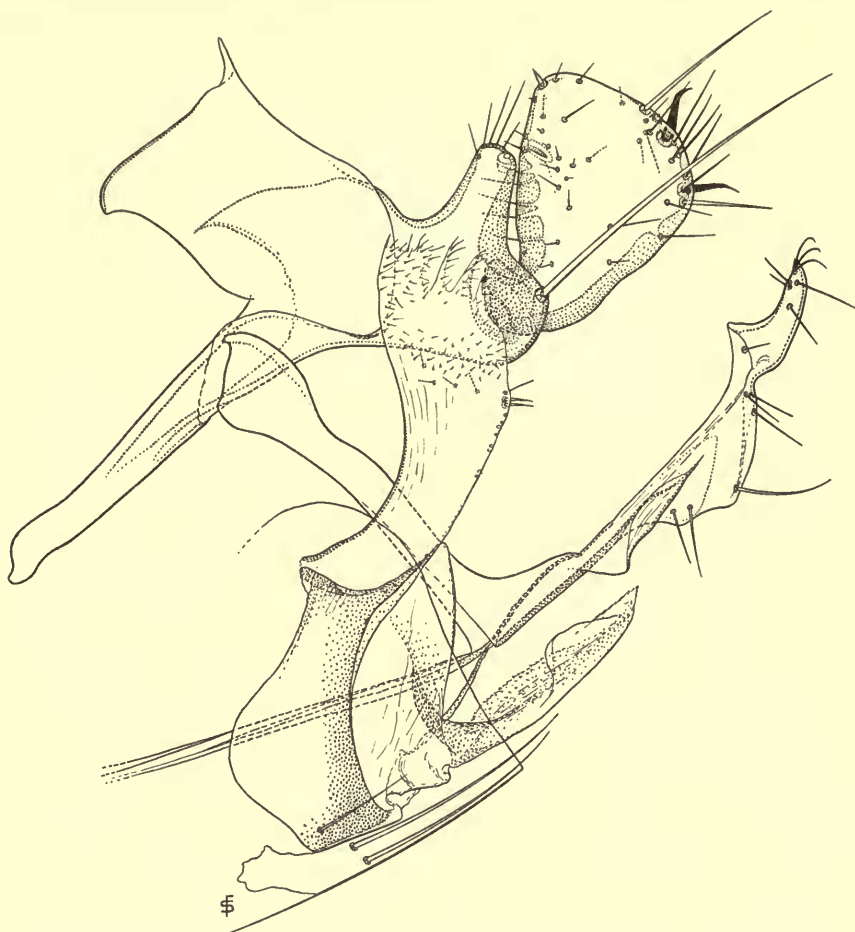


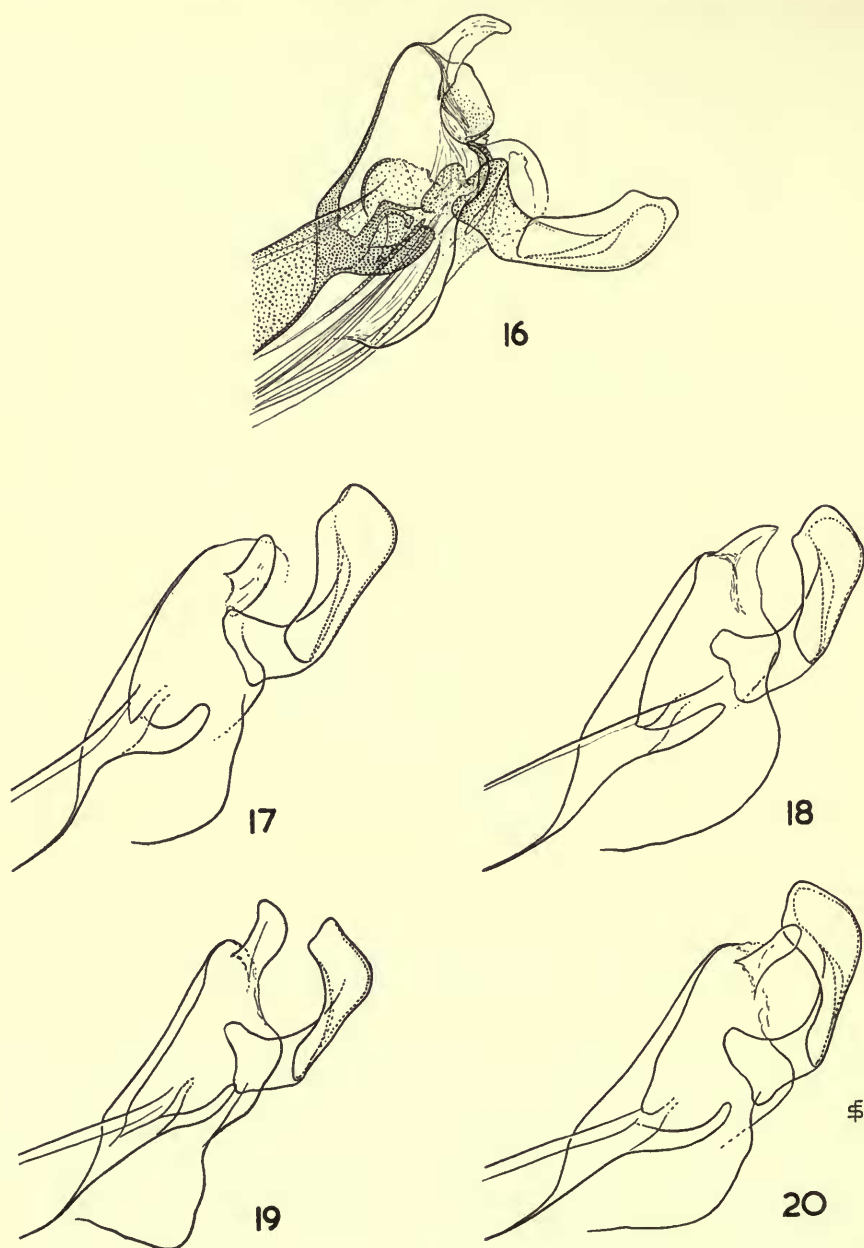
FIG. 15. *Ophthalmopsylla* (*Ophthalmopsylla*) *volgensis palestinica* subsp. nov.
Clasper and sterna VII-IX (holotype).

this arm forms a fairly large triangular lobe which bears half a dozen setae. Aedeagus as in Fig. 16. Thus far no use had been made of the structure of the aedeagus in separating the subspecies of *O. volgensis*. Text-figs. 17-20 show the aedeagi of the four other subspecies of which I have material available for study* ; note the differences in (a) the degree of sclerotization of the dorsal margin, (b) shape and place of attachment of the dorso-apical membranous lobe, (c) the shape of the ventral lateral lobe, and (d) the structure of the hamulus.

Female (Text-fig. 21) : All characters of the terminal segments and of the genitalia are shown in the figure, which obviates a detailed description.

LENGTH : ♂ $2\frac{1}{4}$ mm., ♀ $2\frac{3}{4}$ mm.

* My grateful thanks are due to Dr. M. A. Mikulin, of the Anti plague Research Institute at Alma-Ata, for having sent us specimens of *O. v. intermedia* and *O. v. transcaspica*, and to Col. R. Traub for material of *O. v. arnoldi* which was collected by Dr. H. Hoogstraal of the U.S. Navy Medical Research Unit No. 3.



FIGS. 16–20. Aedeagus of subspecies of *Ophthalmopsylla* (*Ophthalmopsylla*) *volgensis*:
 16. *O. v. palestinica* (holotype). 17. *O. v. volgensis* Wagner & Ioff (from western Kazakhstan). 18. *O. v. arnoldi* Wagner & Argyropulo (from the Van Province, Turkey). 19. *O. v. intermedia* Argyropulo (from Byet-Pak-Dala, eastern Kazakhstan). 20. *O. v. transcaspica* Zagniborodova & Mikulin (from the Kazandshik rayon, Turkmenia).

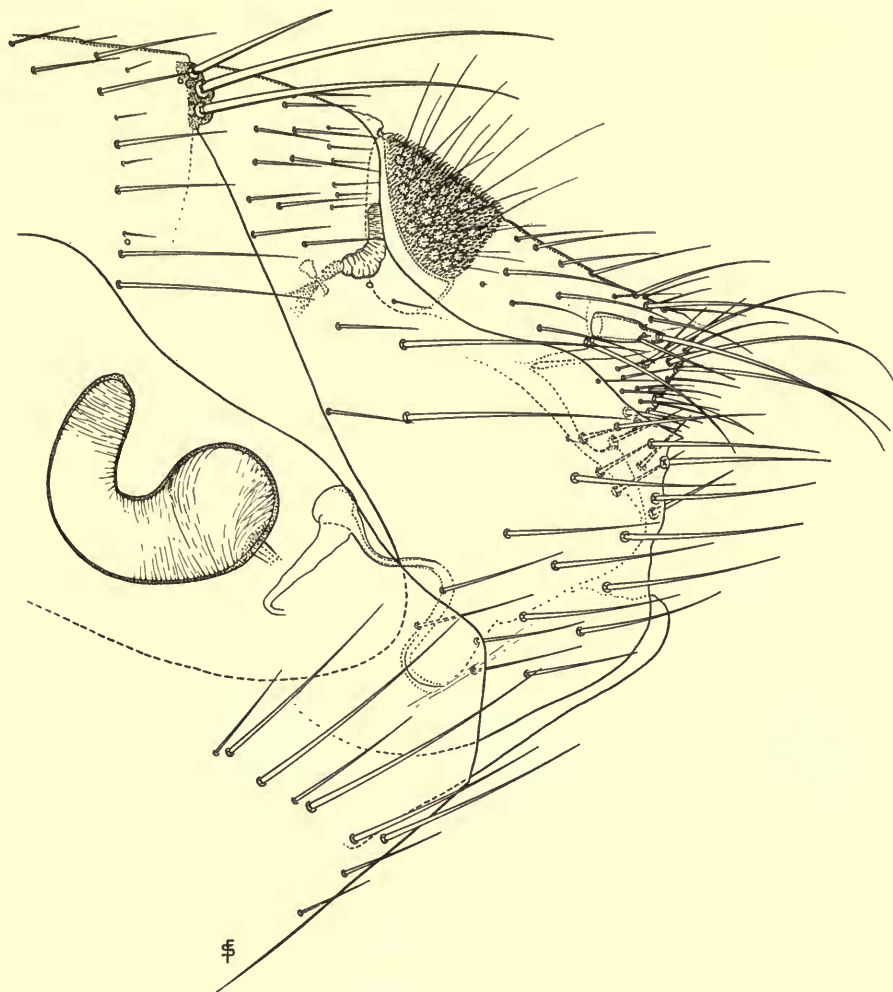


FIG. 21. *Ophthalmopsylla* (*Ophthalmopsylla*) *volgensis palestunica* subsp. nov. Terminal abdominal segments and genitalia (allotype).

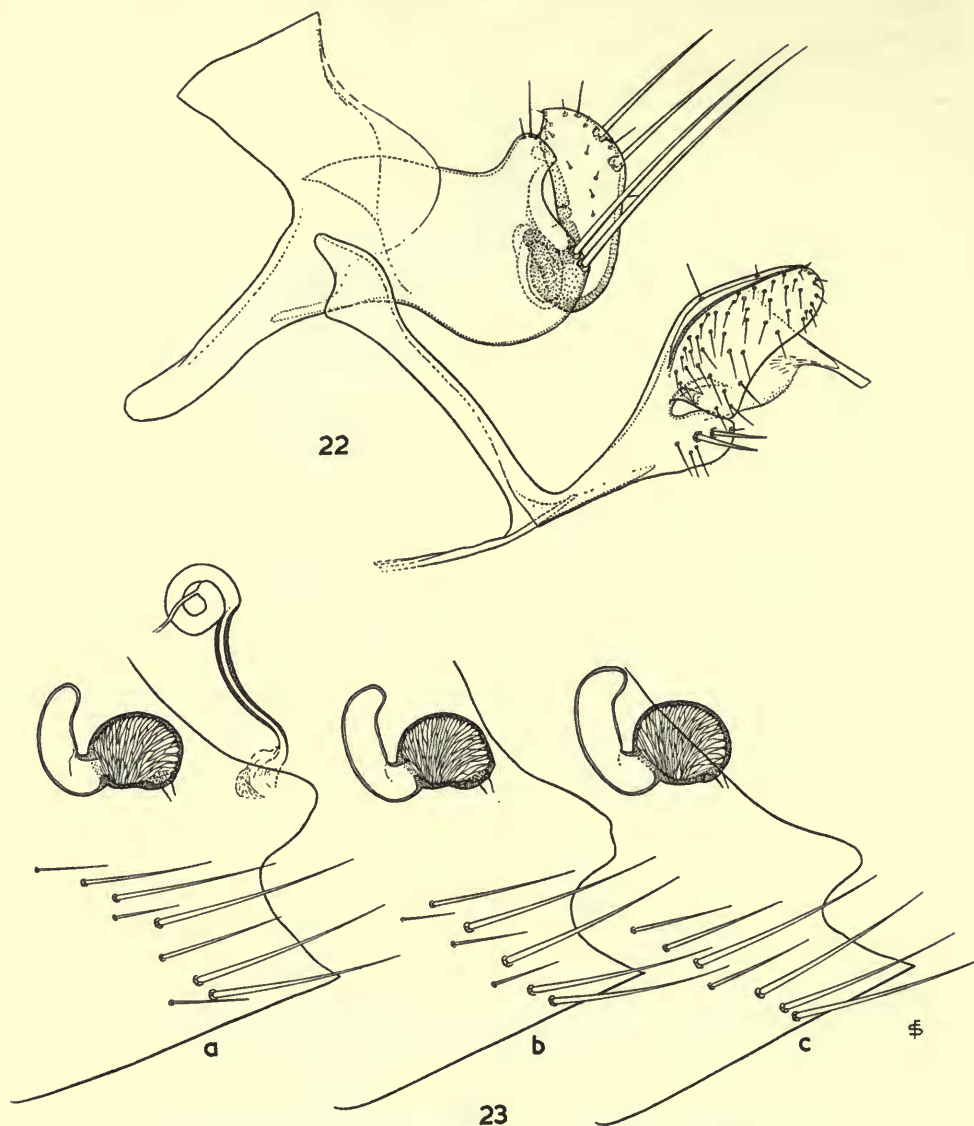
Nosopsyllus (*Nosopsyllus*) *sarinus aryanus* subsp. n.

(Text-figs. 24, 26)

TYPE MATERIAL : Male holotype, female allotype and 1 ♂ 1 ♀ paratypes from Abadan, south-west Iran, from rats, 1936 (*D. C. Rennie*).

DESCRIPTION : This new subspecies differs from the nominate subspecies *N. sarinus sarinus* (Jordan & Rothschild, 1929) (from Adana, Turkey) only in genitalic structures.

Male (Text-fig. 24) : The fixed process of the clasper is longer than in *N. s. sarinus* (Text-fig. 22) and the movable process is widest at about the middle, not in its apical



FIGS. 22, 23. *Nosopsyllus* (*Nosopsyllus*) *sarinus sarinus* (Jordan & Rothschild, 1921).
 22. Clasper, sternum IX and aedeagal hamulus (lectotype). 23. Sternum VII and spermatheca (paratypes).

of the movable process in ssp. *aryanus*. Distal arm of sternum IX (Text-fig. 24) portion; the two strong setae at the posterior margin are situated at a lower level than in the nominate subspecies because of the greater length of the apical portion with a very long and narrow dorsal submarginal sclerotization, characteristic for the species, and one minute apical subspiniform seta. Aedeagal hamulus (Text-fig.

24) with a narrow and rather long apical part, more or less as in the other two subspecies.

Female (Text-fig. 26) : Posterior margin of sternum VII forming a short, broad and very blunt lobe, below which the straight margin meets the ventral margin at an angle approaching a right angle. In *N. sarinus sarinus* (Text-fig. 23 a-c ; the corresponding figures in the original description are not perfectly correct) the posterior margin of sternum VI forms a much more strongly projecting and narrower lobe, below which the margin meets the ventral margin at an acute angle. There are no striking differences in the ductus bursae or in the spermatheca.

LENGTH : ♂ $2-2\frac{1}{4}$ mm., ♀ $2\frac{1}{2}-3$ mm.

Nosopsyllus (Nosopsyllus) sarinus parthius subsp. n.

(Text-fig. 25)

TYPE MATERIAL : Male holotype from Mahun, 6000 ft., about 20 miles S.S.E. of Kirman, Iran, vii-x. 1950, from *Mus musculus*, collected by a member of the Oxford University Expedition to Persia.

DESCRIPTION : This subspecies, only known from the male sex, also differs from the two related forms only by genitalic structures.

Male (Text-fig. 25) : The fixed process of the clasper is about the same length as that of *N. sarinus aryanus*, but is more upright and therefore looks longer. The movable process is longer and narrower than that of the other two subspecies and the angle of the anterior margin, not far from the pointed apex, is much more prominent because the margin between the angle and the apex is concave. Sternum IX and aedeagal hamulus not much different from those of *N. s. sarinus* and *N. s. aryanus* (Text-fig. 25, cf. Text-figs. 22 and 24).

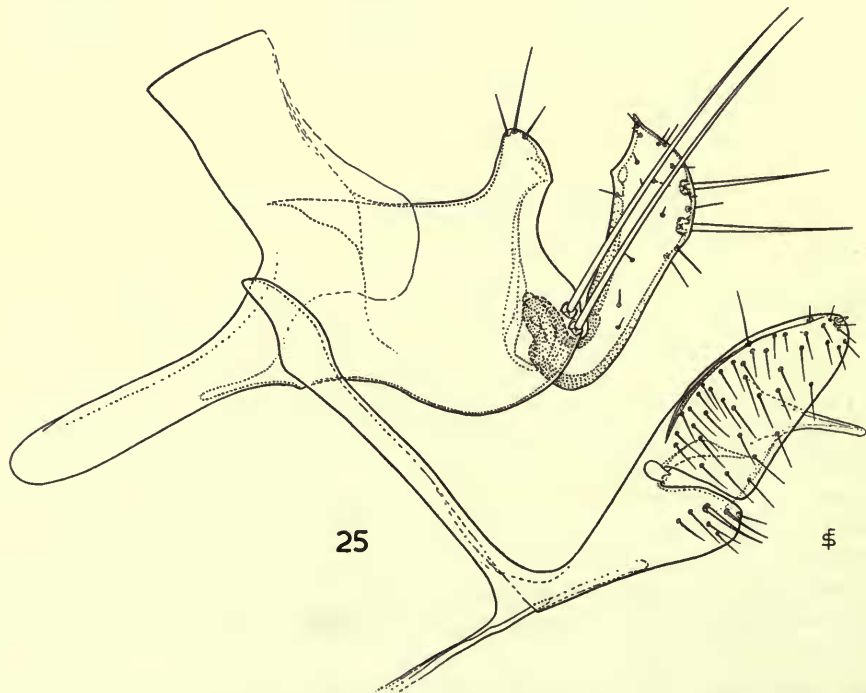
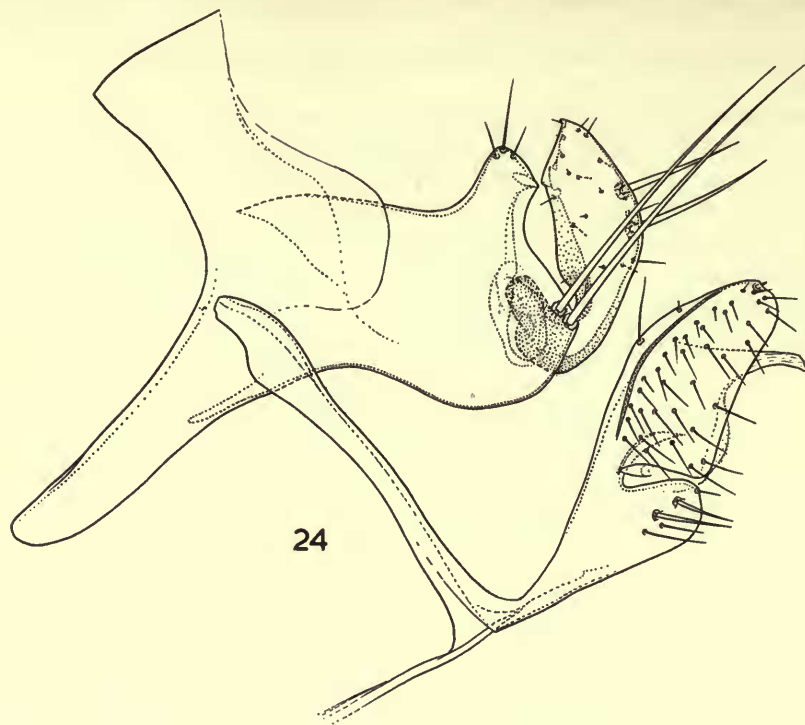
LENGTH : ♂ $2\frac{1}{4}$ mm.

Genus **NOSOPSYLLUS** Jordan, 1933

Nosinius subgen. n.

Distinguishable from the nominate subgenus and from subgenus *Gerbillophilus* by (a) the larger number of pronotal spines (26 or 27 as against an average of 20 in all other species), (b) the more numerous pseudosetae under the mesonotal collar (9 or 10 as against an average of 6 in all other species), (c) the first pair of lateral plantar setae being shifted on to the plantar surface more or less in between the members of the second lateral pair (in some species of the other subgenera there is a tendency towards this shift), (d) the more numerous setae on the abdominal segments ; one or two setae of the tergal main rows are situated below the level of the spiracle in the male, two or three in the female, (e) the subequal length of the three antesensilial setae in the female (in all other species the upper seta never reaches much beyond half the length of the middle seta, and the lower seta is always at least a little shorter than the middle one).

Type of subgenus : the new species described below.



FIGS. 24, 25. Clasper, sternum IX and aedeagal hamulus of: 24. *Nosopsyllus* (*Nosopsyllus*) *sarinus aryanus* subsp. nov. (holotype). 25. *Nosopsyllus* (*Nosopsyllus*) *sarinus parthius* subsp. nov. (holotype).

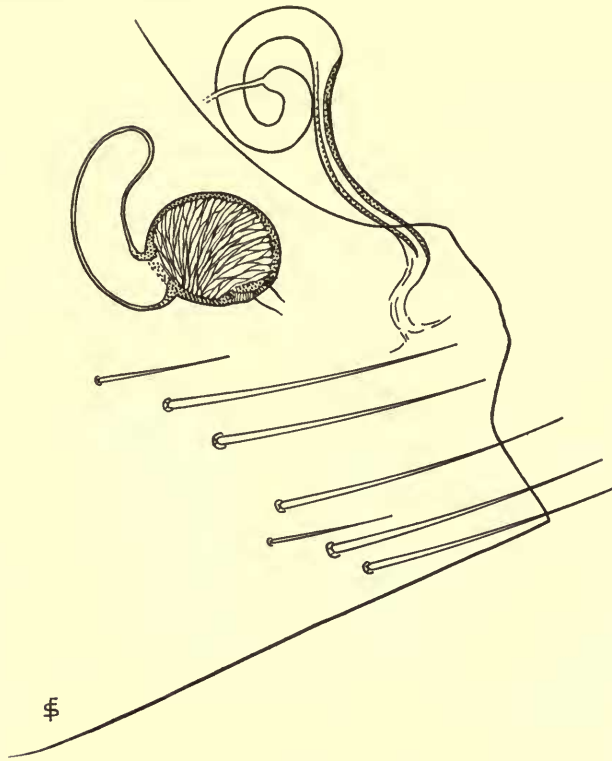


FIG. 26. *Nosopsyllus (Nosopsyllus) sarinus aryanus* subsp. nov. Sternum VII, ductus bursae and spermatheca (allotype).

***Nosopsyllus (Nosinius) sinaiensis* sp. n.**

(Text-figs. 27–30)

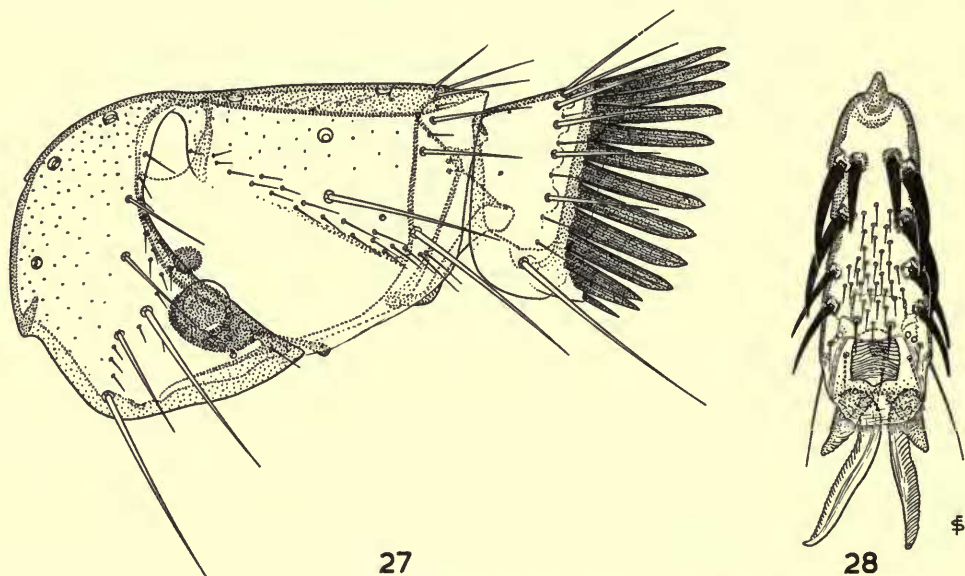
TYPE MATERIAL : Male holotype, female allotype and 1 ♂ paratype from the Libne Junction, Sinai Peninsula, Egypt, from *Gerbillus gerbillus*, xii.1956 (*M. Costa*).

DIAGNOSIS : The new species is immediately distinguishable from all other known members of the genus by the characters mentioned in the description of the sub-genus.

DESCRIPTION : *Head* (Text-fig. 27) : Frontal tubercle about in the middle of the frons in the male, while in the female (in which the exact dorsal end of the frons cannot be determined with certainty owing to the much lower point of implantation of the antennae) the tubercle is situated at a corresponding distance from the oral angle. In front of the antennal fossa, above the well-developed eye, a row of two setae (absent in the female) and a number of minute ones. Ocular row in both sexes consisting of three setae of which the central one is thinner and much shorter than the outer ones. Labial palp reaching to about the apex of the fore coxa. The anten-

nal fossa is dorsally bordered by a row of 19–20 small setae in the male and 12–14 in the female. Postantennal region with one long seta above the middle of the clava. The occipital row consists in the male of five setae each side, of which the lowest is large and is separated by a gap from the more dorsal ones; there is an additional seta near the dorsal margin just in front of the uppermost seta of the occipital row. In the female the occipital row consists of six setae each side and the gap between the lowest seta and the next is much smaller than in the male.

Thorax: Pronotum (Text-fig. 27) with a row of usually 12 setae on the two sides together in both sexes. Pronotal ctenidium with 26 or 27 slender spines in the male, 26 in the female; these spines are a little longer than the pronotum. Mesonotum with two rows of setae, apart from the anterior patch of numerous small setae, most



FIGS. 27, 28. *Nosopsyllus (Nosinius) sinaiensis* sp. nov. 27. Head and pronotum (♂ paratype). 28. Fifth hind tarsal segment (♂ paratype).

of which are covered by the pronotal spines; the first row consists of four or five small setae on each side, the main row of six setae. A row of 9 or 10 pseudosetae each side under collar of the mesonotum. Mesepisternum generally with 10–12 small and two larger setae in the male, in the female with 17 or 18 small ones and two or three larger ones. Mesepimeron with six or seven setae. Metanotum also with two rows of setae which are dorsally preceded by a few small setae; the first row consists of six or seven setae each side, the main row of five or six; the margin of the collar of the metanotum bears one spinelet on each side. The metepisternum has two large and usually one small setae, and the metasternum one; the metepimeron bears 7–9 setae in the male, 9–10 in the female.

Legs: Longest seta of second hind tarsal segment reaching to or a little beyond the apex of the fourth segment. First pair of lateral plantar setae of all tarsi (Text-

fig. 28) shifted on to the plantar surface and placed more or less in between the members of the second lateral pair.

Abdomen : Terga I-VII with two rows of setae and also with one or a few additional small setae in front of the most dorsal ones of the anterior row ; the main row consists in the male of 6, 10, 10 or 11, 10 or 11, 11, 11 and 11 setae per side, in the female of 6, 12, 11 or 12, 11, 11, 10 or 11, and 9 or 10 setae respectively. The posterior margin of terga I-III bears one spinelet on each side in the male (on one

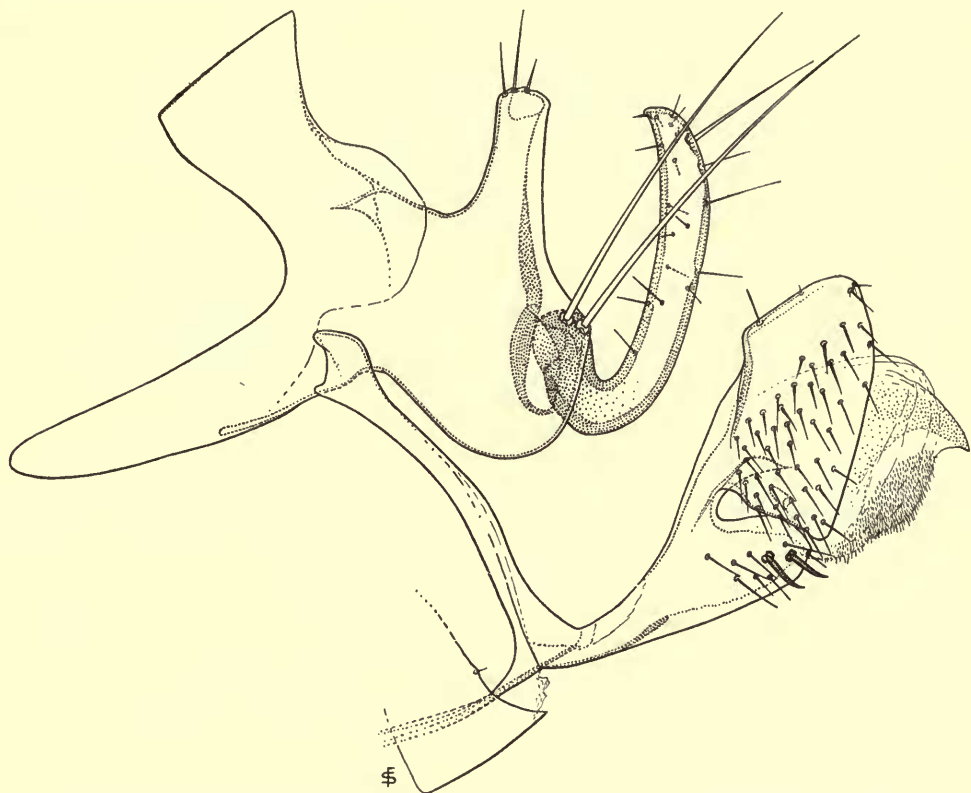


FIG. 29. *Nosopsyllus (Nosinius) sinaiensis* sp. nov. Clasper, sternum IX and aedeagal hamulus (holotype).

side of tergum II two spinelets in one specimen), in the female tergum I bears two spinelets each side, tergum II only one, and the remaining terga have none.

In both sexes three antesensilial setae of which in the male the upper is about one-sixth the length of the middle seta, while the lower is extremely minute ; in the female the three setae are of subequal length.

Basal abdominal sternum of the male with one ventral seta each side, sterna III-VII with a row of four or five setae ; in the female the basal sternum bears, apart from the ventral seta, a lateral patch of 6 or 7 slender setae, while sterna III-VI bear on each side an irregular row of 13 or 14, 8, 9 or 10, and 8 or 9 setae respectively.

Male (Text-fig. 29) : Tergum VIII large, its dorsal margin with 4 or 5 setae ; on the lateral surface of the tergum 14 to 18 setae and 7 or 8 small setae above the spiracular fossa. The vestigial sternum VIII as in Text-fig. 29. Fixed process of clasper very prominent, symmetrical and much longer than broad ; the lower margin of the corpus of clasper strongly and symmetrically rounded. Manubrium

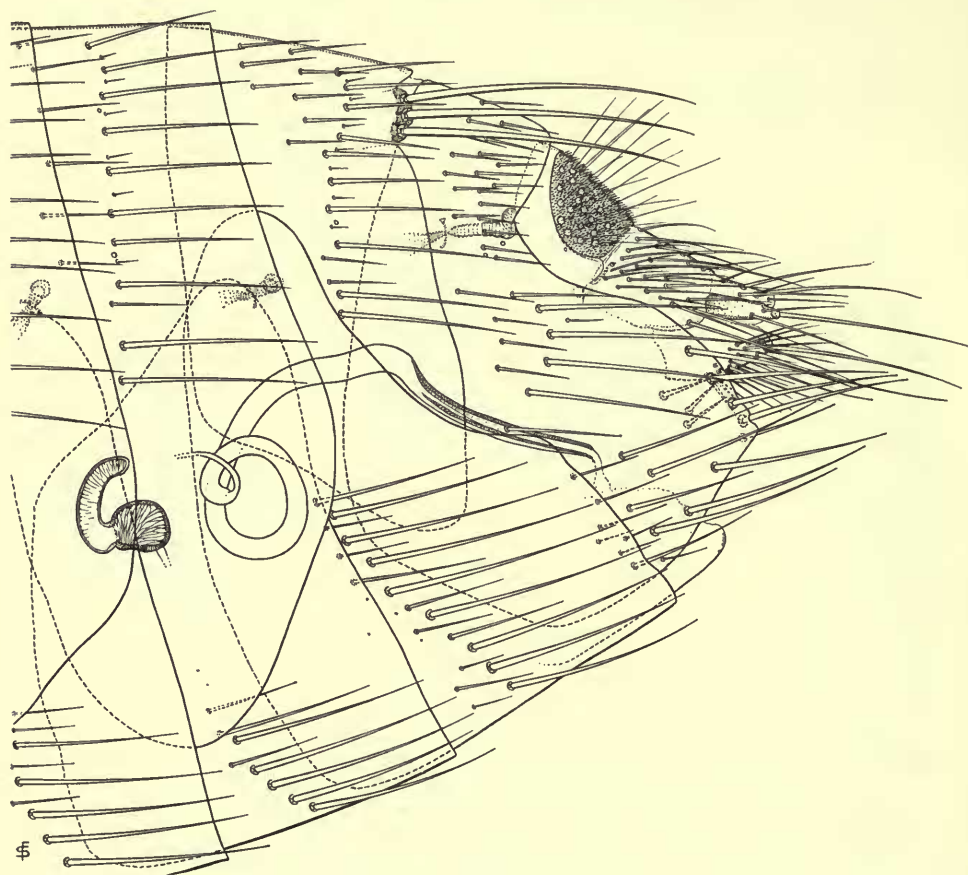


FIG. 30. *Nosopsyllus (Nosinius) sinaiensis* sp. nov. Terminal abdominal segments and genitalia (allotype).

considerably broader than is usual in species of *Nosopsyllus*. Movable process smoothly curved, very narrow and of uniform width throughout, with only one strong seta at the posterior margin, besides several smaller ones. Proximal arm of sternum IX slightly concave anteriorly and convex posteriorly, rather narrow ; the distal arm broad and bearing before the deep ventral constriction two subspiniiform setae and 8 thin ones ; the part of the distal arm beyond the constriction has a distinct hump of the dorsal margin and there are numerous small setae none of

which is really spiniform or subspiniform. Aedeagal hamulus large, shaped as shown in Text-fig. 29.

Female (Text-fig. 30) : The lower third of the posterior margin of sternum VII is almost straight and forms a right angle with the ventral margin ; above this straight portion the margin is concave ; on each side of this sternum an irregular row of 9-11 large and 7-8 smaller setae. Tergum VIII bears 18-20 small setae on the dorsal area (the patch extending to a little below the spiracular fossa), a row of 4 or 5 long setae, preceded by 4 or 5 shorter ones, below the sensillum, and on the ventral and apical area of this tergum 17-19 larger and smaller setae and 2 or 3 genital setae. The anal stylet is about $3\frac{1}{2}$ times as long as basally broad and bears, apart from the long apical seta, two slender and one minute preapical setae. Ductus bursae and spermatheca (Text-fig. 30) of the shape characteristic for the genus, the spermatheca relatively very small.

LENGTH : ♂ $3\frac{1}{4}$ mm., ♀ 4 mm. (larger than any other known species of the genus).

Nosopsyllus (Gerbillophilus) iranus attenuatus subsp. n.

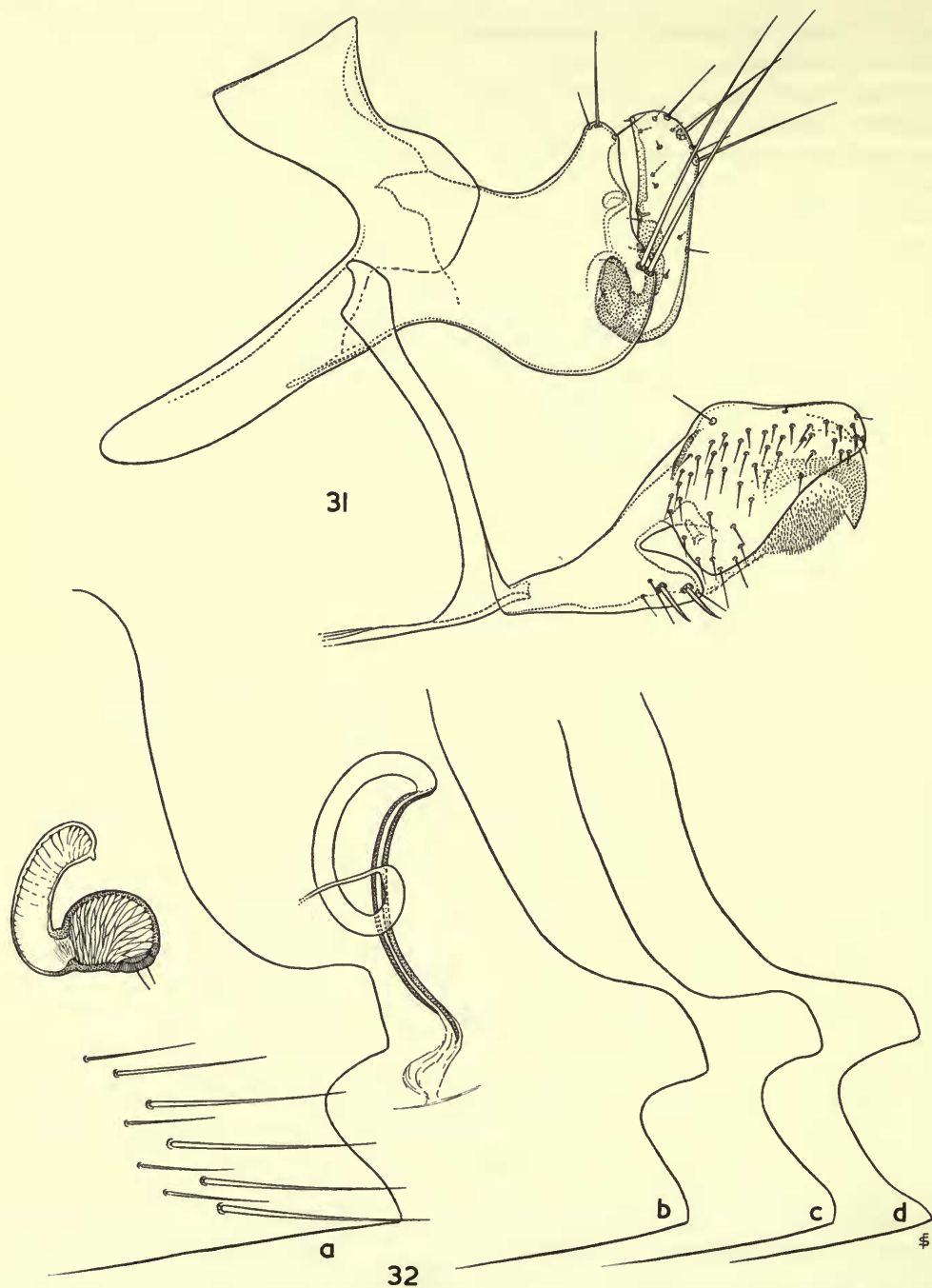
(Text-figs. 31, 32)

TYPE MATERIAL : Male holotype, female allotype and 2 ♂ paratypes from Dan, Israel, from *Meriones tristrami*, 1.iv.1954 (*M. Costa*) ; 1 ♀ paratype from Dan, from *Apodemus sylvaticus* (accidental occurrence), 1.iv.1954 (*M. Costa*) ; 2 ♂, 4 ♀ paratypes from Tel Amal, Israel, from *Meriones tristrami*, 15.ii.1953 (*M. Costa*).

DESCRIPTION : This new subspecies differs from *N. iranus iranus* Wagner & Argyropulo, 1934 (from Azerbaijan and Nakhichevan, mainly on *Meriones bogdanovi*) by the following characters : (a) two setae (instead of three) of the second hind tarsal segment reach well beyond the apex of the fourth segment (in the females sometimes only one), (b) the manubrium is relatively longer, (c) the fixed process of the clasper (Text-fig. 31) is much narrower than in the nominate subspecies, (d) the movable process is relatively shorter and does not reach much beyond the tip of the fixed process, (e) the apex of the distal arm of sternum IX is narrower, (f) the tip of the sclerotized part of the hamulus projects a little beyond the finely hirtose membranous ventral lobe. There are apparently no sharp differences between the two subspecies in the female terminal abdominal segments and genitalia (Text-fig. 32, cf. Text-fig. 34), but the lobe of the posterior margin of sternum VII is apparently more truncate, on the average, in ssp. *attenuatus* than in the nominate subspecies.

LENGTH : ♂ $2\frac{1}{2}$ - $2\frac{3}{4}$ mm., ♀ $2\frac{1}{2}$ -3 mm.

REMARKS : *Nosopsyllus iranus iranus* was described from specimens from Belyasuvar, Azerbaijan, where it was collected in considerable numbers from nests of *Meriones bogdanovi* and a few specimens from *Rattus norvegicus* (which live there in close association with the gerbils) (Wagner & Argyropulo, 1934 : 222). Although the original material contained specimens of both sexes, the female was not described, but in 1935 Argyropulo gives a short diagnosis and figures of that sex (pp. 163, 164,



FIGS. 31, 32. *Nosopsyllus (Gerbilophilus) iranus attenuatus* subsp. nov. 31. Clasper, sternum IX and aedeagal hamulus (holotype). 32. Sternum VII, ductus bursae and spermatheca (a, allotype) and outlines of sternum VII of three paratypes (b from Dan, c and d from Tel Amal).

figs, 34a, 36b, 37a), as well as a more complete figure of the male terminalia (figs. 6, 35 No. 1), and adds as localities Dash-Burun, Leonarkh and Nakhichevan. Argyropulo and Yavrumov (1937 : 81, 82) give additional records of *N. iranus* from the Mil'skaya steppe, Azerbaijan (Stantsia Begmanly/Araks, on *Plassiomys erythrourus* ; Stantsia Tropicheska, on *Meriones bogdanovi*), the southern part of the Muganskaya steppe, Azerbaijan, and from the Nakhichevan A. S. S. R. (Nakhichevan, Dzhul'fa and

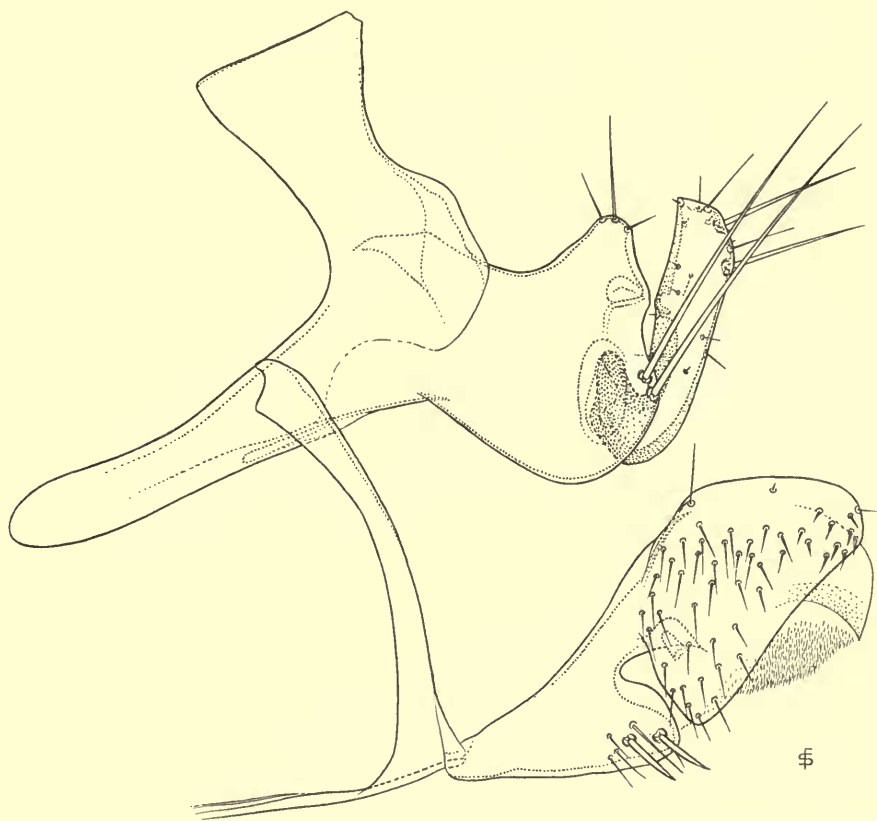


FIG. 33. *Nosopsyllus (Gerbillophilus) iranus iranus* Wagner & Argyropulo (from Kazvin, Iran). Clasper, sternum IX and aedeagal hamulus.

Ordubad, on *Meriones* sp.), and they suggest that this species might be more properly placed as a subspecies of the North African *Nosopsyllus henleyi*—an opinion with which I cannot concur.

I have not seen any material of *N. iranus* from Transcaucasia, and have relied for the diagnosis of the new subspecies, described above, entirely on the original description and on Argyropulo's figures which have the appearance of being accurate, though somewhat sketchy.

A few years ago I received through the courtesy of Dr. G. Bouvier one male and

one female of a *Nosopsyllus* collected at Kazvin, Iran, from a burrow of *Meriones persicus*, in 1955 by Dr. F. Schmid. I identify this pair tentatively as belonging to *Nosopsyllus iranus iranus* Wagner & Argyropulo and give here figures of the structures of taxonomic importance of these Iranian specimens (Text-figs. 33, 34). There

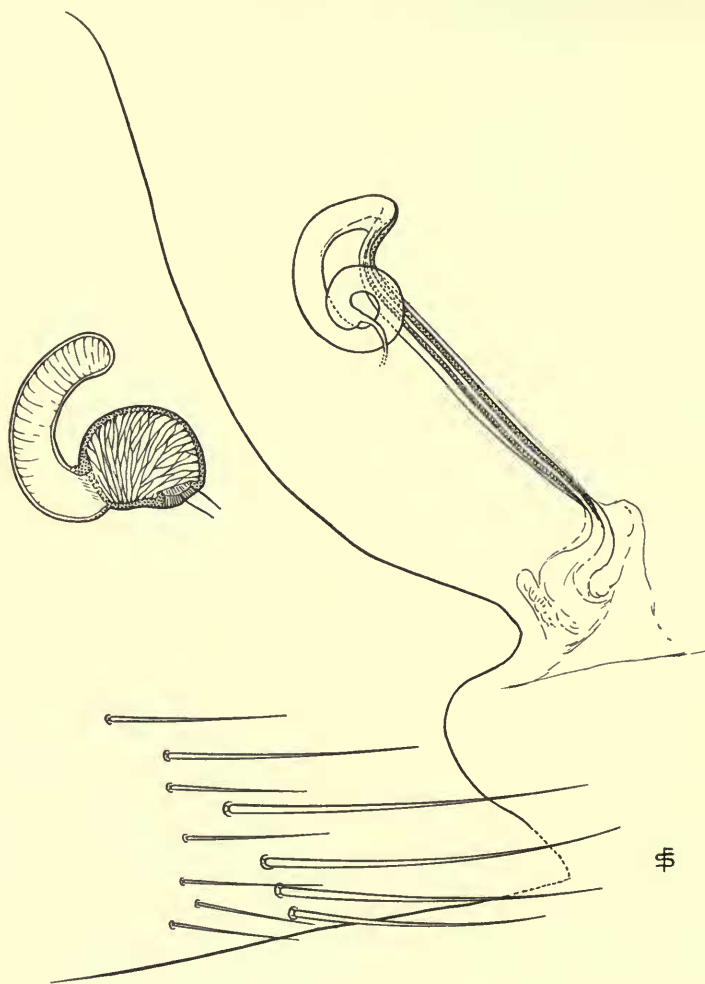


FIG. 34. *Nosopsyllus (Gerbillophilus) iranus iranus* Wagner & Argyropulo, (from Kazvin, Iran). Sternum VII, ductus bursae and spermatheca.

are a few discrepancies between some characteristics of this pair and the published description, but they are rather small and probably come within the range of individual variation : in the Kazvin specimens (*a*) the mouthparts forming the proboscis reach to the apex of the fore trochanter (to about the middle of the trochanter in the specimens from Azerbaijan and from Israel), (*b*) the manubrium is relatively longer, (*c*) the fixed process of the clasper is somewhat narrower than in the nominate

subspecies and its dorso-posterior margin is slightly concave, not straight as shown in Argyropulo's figures; however, this difference may well be unimportant since it is stated in the original description that the shape of the fixed process is variable.

The species *N. iranus* is clearly a parasite of gerbils of the genus *Meriones*.

***Nosopsyllus (Gerbillophilus) henleyi israelicus* subsp. n.**

(Text-fig. 35)

TYPE MATERIAL: Male holotype from Revivim, Israel, from *Meriones tristrami*, 25.iii.1954 (*M. Costa*).

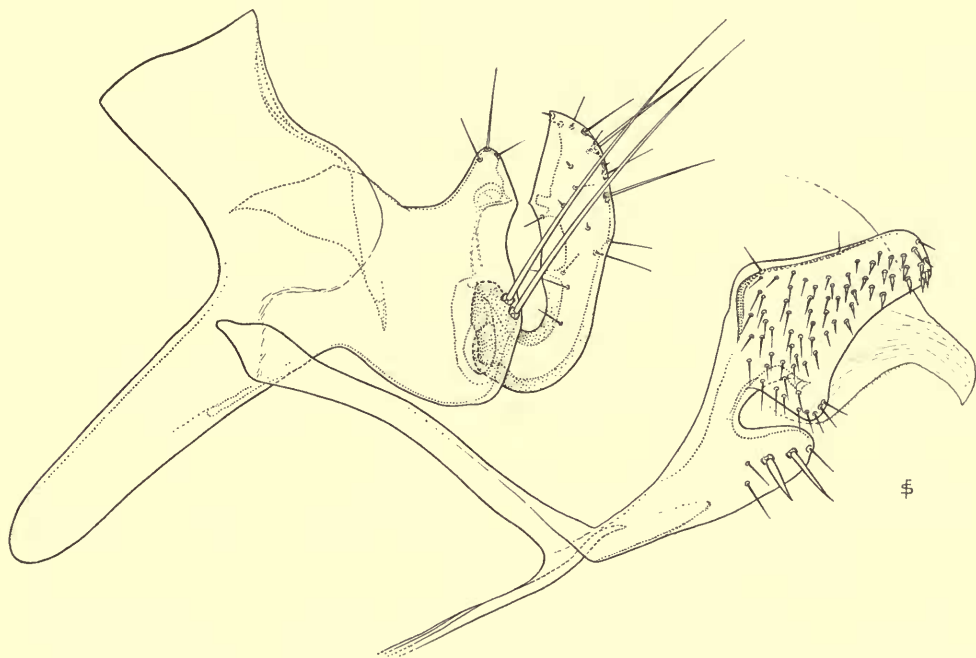


FIG. 35. *Nosopsyllus (Gerbillophilus) henleyi israelicus* subsp. nov. Clasper, sternum IX and aedeagal hamulus (holotype).

DESCRIPTION: This new subspecies is nearest related, as might be expected on geographical grounds, to *N. henleyi henleyi* (Rothschild, 1904), from Bir Victoria, about 300 miles north-west of Cairo, in the Western Desert Province of Egypt. Apart from the somewhat greater length of the upper antesensilial seta (which is almost one-third the length of the middle seta), the new subspecies differs only by details of the genitalia from the nominate subspecies, from *N. henleyi mauretanicus* (Jordan & Rothschild, 1912) (in Algeria) and from *N. henleyi oranus* (Jordan, 1931) (in Algeria and Morocco).

Male (Text-fig. 35): Tergum VIII as in the other subspecies. Manubrium of clasper fairly broad; fixed process almost as in the nominate subspecies; movable process widest just above the middle, beyond which the process narrows gradually;

the two strong setae at the posterior margin of the movable process are placed at a lower level than in the nominate subspecies. Sternum IX as in Text-fig. 35 ; as in the other subspecies the more apical setae on the distal arm are modified into small spiniforms and subspiniforms. Aedeagal hamulus with a weakly sclerotized but rather broad apical lobe.

LENGTH : ♂ $2\frac{3}{4}$ mm.

Nosopsyllus (Gerbillophilus) theodori sp. n.

(Text-figs. 36–38)

TYPE MATERIAL : Male holotype and 1 ♂ paratype from El Hadhira, Israel, from *Meriones crassus* (holotype) and *Acomys russatus* (paratype) 20.xii.1954, (*O. Theodor*) ; female allotype and 5 ♂ 3 ♀ paratypes from Wadi Jureir, Negev, Israel, from *Meriones crassus* (allotype and 4 ♂, 2 ♀ paratypes) and *Gerbillus (Dipodillus) dasyurus* (1 ♂, 1 ♀ paratypes), 1.iv.1955 (*M. Costa*) ; 1 ♂ paratype from Wadi Nafkh, Israel, from *Gerbillus (Dipodillus) dasyurus*, 11.iv.1955 (*M. Costa*) ; 1 ♂, 1 ♀ paratypes from Raman, Trias, Israel, from *Meriones calurus* (♂) and *M. crassus* (♀), 18.iii.1956 (*M. Costa*) ; 1 ♂, 3 ♀ paratypes from Ras ez Zuweira, Israel, from *Gerbillus (Dipodillus) dasyurus* (1 ♂, 2 ♀) and *Acomys cahirinus* (1 ♀), 3.iii.1955 (*M. Costa*) ; 1 ♂ paratype from Shirta, Israel, from *Gerbillus (Dipodillus) dasyurus*, 23.xi.1957 (*M. Costa*) ; 1 ♂ paratype from Wadi Adjad, Israel, from *Gerbillus (Dipodillus) dasyurus*, 16.xi.1957 (*M. Costa*) ; 1 ♂, 1 ♀ paratypes from Beerotayim, Israel, from *Meriones crassus* (♂) and *Gerbillus (Dipodillus) dasyurus* (♀), 25.iii.1957 (*M. Costa*).

DESCRIPTION : It is difficult to assess the relationship of this and the following new species to any of the known species of the subgenus ; there are, as far as I can make out, no species which are particularly closely related to them. There is a great need for a revision of the genus *Nosopsyllus*.

Labial palp reaching to the middle of the fore trochanter. Pronotal ctenidium consisting of 20–23 spines which are distinctly longer than the pronotum. Longest seta of first hind tarsal segment subequal in length to this segment ; longest seta of second hind tarsal segment reaching to about the middle of the fifth segment, and a second seta reaching to about the apex of the fourth segment or a little beyond. The first three abdominal terga with one or two marginal spinelets each side. Spiracular fossae of terga II–VII very small, only slightly larger than the alveoli of the larger tergal setae. Upper antensensilial seta in the male about one-third the length of the middle seta, the lowest seta minute or absent ; in the female the upper seta is about one-third the length of the lower, while the latter is distinctly shorter than the middle seta.

Male (Text-figs. 36, 38) : Tergum VIII (Text-fig. 38) of medium height, with a dorso-posterior angle of about 90°. Manubrium of clasper (Text-fig. 36) straight and fairly narrow ; fixed process very narrow, the posterior margin of the clasper below it strongly sinuate ; movable process narrow and straight, with a prominent pointed angle at the middle of the anterior margin ; chaetotaxy of the movable process as

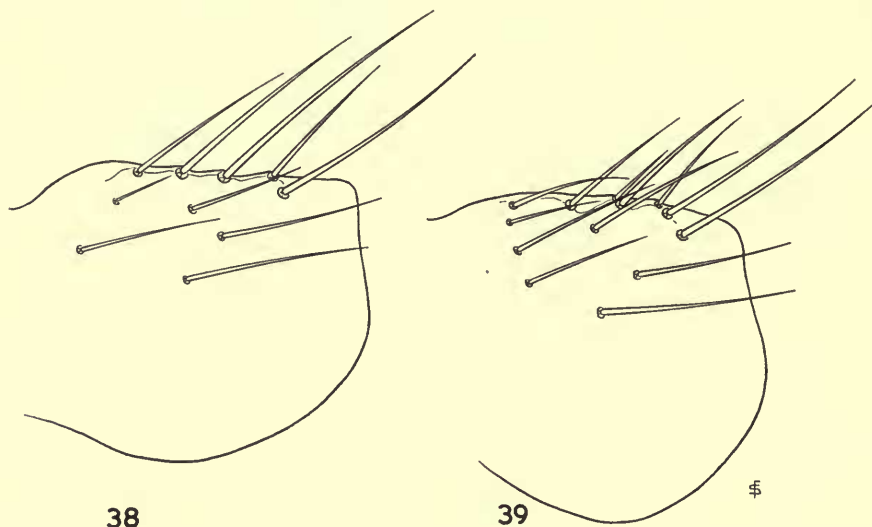


FIGS. 36, 37. *Nosopsyllus (Gerbillophilus) theodori* sp. nov. 36. Clasper, sternum IX and aedeagal hamulus (holotype). 37. Sternum VII, ductus bursae and spermatheca (a, allotype) and outlines of sternum VII of three paratypes (b and d from Wadi Jureir, c from Ras ez Zuweira).

shown in Text-fig. 36. Apical part of distal arm of sternum IX broad, its dorsal margin strongly angulate; only a few apical setae are slightly thickened, none is spiniform. Aedeagal hamulus with a non-protruding sock-shaped sclerotization, as shown in Text-fig. 36.

Female (Text-fig. 37): Posterior margin of sternum VII with a fairly narrow but well-developed blunt lateral lobe; chaetotaxy as in Text-fig. 37. Ductus bursae of medium length; spermatheca as shown in Text-fig. 37.

LENGTH: ♂ 2-2½ mm., ♀ 2½-3 mm.



FIGS. 38, 39. Tergum VIII of male of: 38. *Nosopsyllus (Gerbillophilus) theodori* sp. nov. (paratype from Raman). 39 *N. (G.) pumilionis* sp. nov. (holotype).

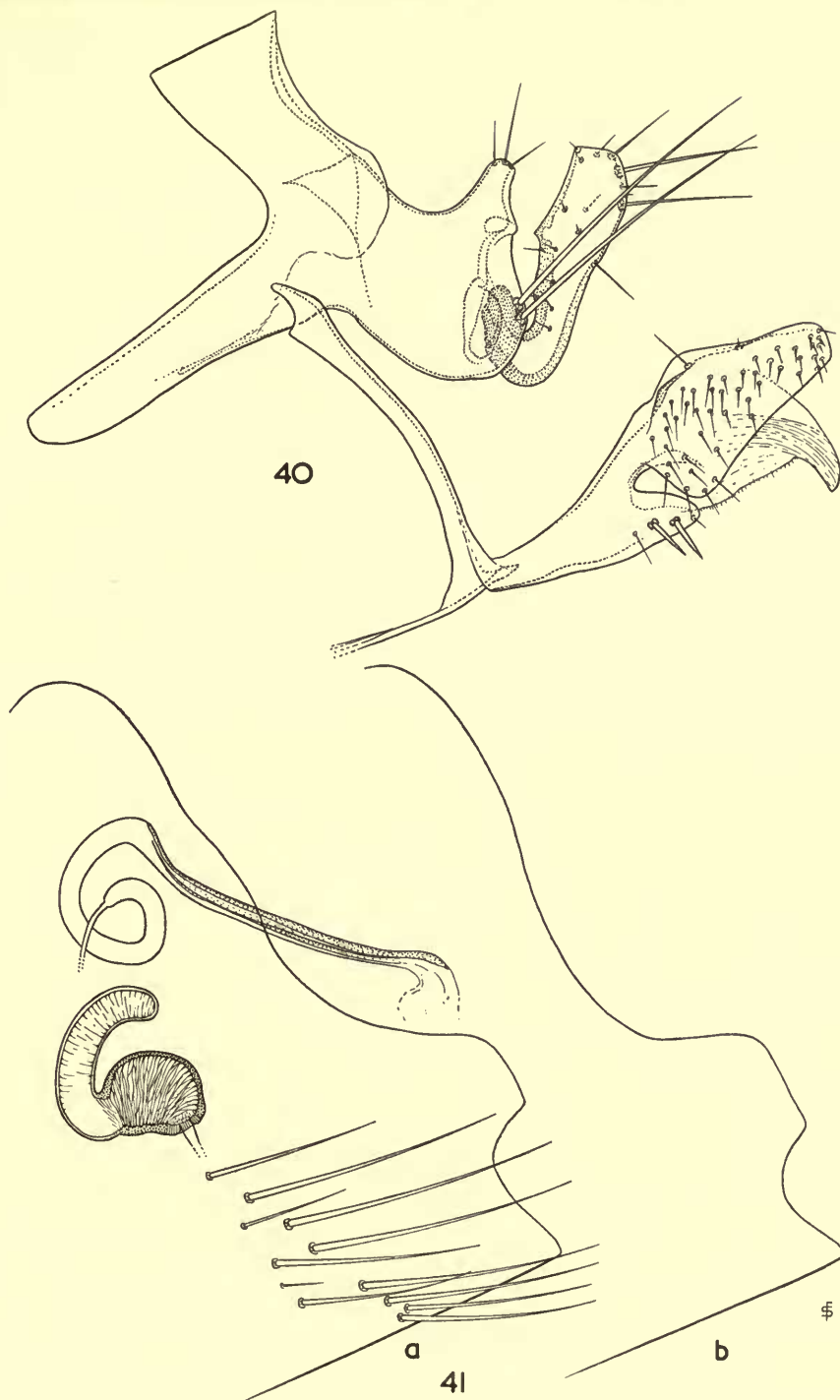
***Nosopsyllus (Gerbillophilus) pumilionis* sp. n.**

(Text-figs. 39-41)

TYPE MATERIAL: Male holotype, female allotype and 1 ♀ paratype from Ein-Radian, Israel, from *Dipodillus nanus*, 1.ii.1953 (*M. Costa*); 1 ♂ paratype from Ein Radian, Israel, from *Jaculus jaculus*, 15.iv.1955 (*M. Costa*); 1 ♂, 3 ♀ paratypes from Tureibe, Israel, from *Meriones crassus*, 2.iv.1956 (*M. Costa*).

DESCRIPTION: A fairly close relative of *N. theodori* and, apart from somewhat larger abdominal spiracular fossae and a shorter upper antesensilial seta in the male (length of this seta only one-fourth that of the middle seta), only distinguishable from it by the modified terminal segments.

Male (Text-figs. 39, 40): Tergum VIII (Text-fig. 39) much higher than in the previous species, its ventral margin strongly convex and the dorso-posterior angle obtuse. Manubrium of clasper (Text-fig. 40) relatively shorter and broader than in *N. theodori*; fixed process narrow as in that species, but the margin of the clasper below it only feebly sinuate; movable process widest in the apical half, with a sharply



FIGS. 40, 41. *Nosopsyllus (Gerbillophilus) pumilionis* sp. nov. 40. Clasper, sternum IX and aedeagal hamulus (holotype). 41. Sternum VII, ductus bursae and spermatheca (a, allotype) and outline of sternum VII of paratype (b).

pointed angle at the middle of the anterior margin ; chaetotaxy of movable process as shown in Text-fig. 40. Distal arm of sternum IX fairly narrow and straight, none of the small setae on the apical portion of this arm markedly thickened. Aedeagal hamulus with a long apical lobe, which projects far beyond the general outline of the structure (Text-fig. 40).

Female (Text-fig. 41) : Posterior margin of sternum VII with a blunt lateral lobe which is much broader than in *N. theodori*. Ductus bursae fairly long ; spermatheca as in Text-fig. 41.

LENGTH : ♂ $2\frac{1}{2}$ mm., ♀ 3 mm.

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